REMARKS

Information Disclosure Statement

An Information Disclosure Statement is being filed concurrently with this Preliminary Amendment. The IDS cites two related pending US applications: application serial no. 09/065,944 filed April 24, 1998, and application serial no. 09/651,217 filed August 30, 2000. The 09/065,944 application is a CIP of the present application. The 09/651,217 application is a division of the 09/065,944 application.

Rejections Under 35 USC §112, second paragraph

Claims 42-44 have been rejected under 35 USC §112, second paragraph, as being indefinite. In response to these rejections, claim 42 has been amended to change "a dielectric strength to --the dielectric strength--.

In claim 1 "at" at lines 7 and 16-17 has been changed to --in--.

Rejections Under 35 USC §103

Claims 1-20 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. in view of either Nishino et al. (US Patent No. 5,739,205) or Litke (US Patent No. 4,533,422).

Claims 1-20 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. in view of Mikuni et al. (US Patent No. 5,175,337) and further in view of either Nishino et al. (US Patent No. 5,739,205) or Litke (US Patent No. 4,533,422).

Claims 1-20 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. in view of either Nishino et al. (US Patent No. 5,739,205) or Litke (US Patent No. 4,533,422) and further in view of O'Sullivan et al. (US Patent No. 3,832,334).

Claims 21-42 and 40-44 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. (US Patent No.

4,209,358) in view of Burnett et al. (US Patent No. 2,628,178) and Gruber et al (US Patent No. 3,987,019).

The rejections under 35 USC §103(a) are traversed for the reasons to follow.

Argument

The pending claims are directed to a "method for packaging a semiconductor die to form a semiconductor package". The method includes the step of "providing a leadframe configured for wire bonding to the die". The method also includes the step of "providing a cyanoacrylate adhesive material (or an anaerobic acrylic) formulated to cure in contact with the die in less than about 60 seconds in a temperature of about 20°C to 30°C and an ambient atmosphere". Each of the independent claims has been amended to include the "in contact with the die" recitation. Antecedent basis is provided on page 4, lines 19-20 of the specification. The die is also stated in each independent claim to be a "semiconductor die" such that the adhesive is in contact with a semiconductor material. Further, each independent claim recites a "curing" step in which the curing of the adhesive material "bonds the die to the leadframe".

In the previous Amendment dated March 14, 2100 Applicant had argued that the references cited in the 35 USC §103 rejections do not teach distinguishing features of the present invention. In response the Examiner stated in the Office Action dated June 18, 2001 that Applicants arguments had considered the cited references "piecemeal" rather than in combination. Accordingly, Applicant will restate the previous arguments but from the viewpoint of the teachings of the references in combination.

However, Applicant would also ask the Examiner to assess the claims "as a whole" in evaluating unobviousness. (See for example Schenck v. Norton Corp., 713 F.2d 782, 218 U.S.P.Q. 698 (July 21, 1983)). In this regard although features of the claims may be known in the art, the claims

are to be assessed "as a whole" from the view point of one skilled in the art at the time of the invention, but without the benefit of the present disclosure.

A first distinguishing feature of the claims is bonding a semiconductor die to a leadframe using a cyanoacrylate adhesive (or an anaerobic acrylic adhesive) formulated to cure at room temperature is less than sixty seconds. The cited references in combination do not suggest bonding a semiconductor die to a leadframe using a room temperature instant curing adhesive. For example, Nishino et al. states at column 1, lines 9-11 that:

"cyanoacrylates have been widely used as instantaneous adhesives for adhesion of rubbers, plastics, metals, glasses and woods."

However, there is no mention in Nishino et al. of bonding a semiconductor to anything using a cyanoacrylate adhesive (or an anaerobic acrylic adhesive).

DiLeo et al. was cited as teaching bonding a semiconductor device to a leadframe using a "room temperature curing epoxy". However, this falls short of teaching a room temperature curing material that also cures in contact with a semiconductor in less than sixty seconds. Most curable adhesives will cure at room temperature provided a long enough time period is provided, because the typical curing mechanism is outgassing of a solvent. This curing mechanism is accelerated at higher temperatures such that the conventional wisdom in the semiconductor die attach art is to use higher temperatures to speed up the curing process. The present invention recognizes that an improved semiconductor package can be fabricated using an adhesive composition formulated to cure in contact with a semiconductor die at room temperature in less than sixty seconds. (DiLeo et al. uses the words "instant bonding technique" at column 3. line 37. However, this passage does not refer to a time frame for

curing a room temperature adhesive, but rather can be paraphrased as the "present" bonding technique.)

Also with respect to DiLeo et al., the Office Action states at the top of page 4, that the explicit teaching of a room temperature curing adhesive would "clearly suggest such use" to those of ordinary skill in the art. Applicant would respond that the "suggested use" in DiLeo et al. is room temperature curing but without the presently claimed time frame of less than one minute. Applicant would further submit that as there are no anticipatory references on the concept of bonding a semiconductor die to a leadframe using a room temperature instant curing adhesive, the present use is not clearly suggested. This assertion is reinforced by the December 4, 1978 priority date of DiLeo et al., which is almost twenty years prior to the priority date of the present application. In that time period many dice have been attached to many leadframes, but there are no anticipatory references on doing it with a room temperature instant curing adhesive.

A second distinguishing feature recited in each independent claim is the step of providing fillers in the adhesive. Admittedly fillers have been used in the past in room temperature instant curing adhesives. However, in this case the fillers are selected to tailor the adhesive layer to the requirements of the package. As stated on page 4, lines 24-27 of the specification:

"Commercial formulations of these adhesives can be modified to tailor the characteristics of the cured adhesive layer to electronics packaging."

In order to emphasize this distinction independent claim 1 has been amended to recite the step of: "providing a filler in the adhesive material selected to tailor a characteristic of the package".

Applicant would argue that the cited art does not disclose a semiconductor package with a room temperature instant curing adhesive having a filler which functions as

stated above. Accordingly, even if fillers have been used in the past they have not been used to perform the above stated function.

Independent claim 15 has been amended similarly to claim 1 to recite the step of: "providing a filler in the adhesive material selected to tailor a characteristic of the adhesive layer in the package". Again as this has not been done in semiconductor packaging in a room temperature instant curing adhesive this recitation is submitted to patentably distinguish the above claim from the cited art.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 1-22, and 40-44 is requested. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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September 18, 2001
Date of Signature

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MARKED VERSION OF AMENDED CLAIMS SHOWING CHANGES

1. (four times amended) A method for packaging a semiconductor die to form a semiconductor package comprising:

providing a leadframe configured for wire bonding to the die;

providing a cyanoacrylate adhesive material formulated to cure in contact with the die in less than about 60 seconds [at] in a temperature of about 20°C to 30°C and [in] an ambient atmosphere;

providing a filler in the adhesive material selected to [improve] tailor a characteristic of [the adhesive material in] the package;

applying the adhesive material to the leadframe or to the die;

placing the die on the leadframe with the adhesive material in contact with the die and the leadframe to form an adhesive layer therebetween; and

curing the adhesive material [at] in the temperature and [in] the ambient atmosphere in less than about 60 seconds to bond the die to the leadframe.

[;]

[wire bonding the die to the lead frame; and]

[encapsulating the die.]

6. (five times amended) A method for packaging a semiconductor die to form a semiconductor package comprising:

providing a leadframe comprising a plurality of lead fingers configured to support the die and configured to provide sites for wire bonding to the die;

providing a cyanoacrylate adhesive material formulated to cure in contact with the die in less than about 60 seconds at a temperature of about 20°C to 30°C and in an ambient atmosphere;

providing a filler in the adhesive material selected to improve a dielectric strength of the adhesive material in the package;

applying the adhesive material to the leadframe or to the die;

placing the die on the leadframe with the adhesive material compressed between the die and the leadframe to form an adhesive layer therebetween;

curing the adhesive material at the temperature and in the ambient atmosphere in less than about 60 seconds to bond the die to the leadframe;

wire bonding the die to the lead fingers; and

encapsulating the die.

12. (five times amended) A method for packaging a semiconductor die to form a semiconductor package, comprising:

providing a leadframe comprising a plurality of lead fingers configured for wire bonding to the die;

applying an adhesive material on the lead fingers or on the die, the adhesive material comprising a cyanoacrylate adhesive formulated to cure in contact with the die in less than about 60 seconds at a temperature of about 20°C to 30°C and in an ambient atmosphere, and an electrically insulating filler configured to increase a dielectric strength of the adhesive material; [to inhibit cross talk between the lead fingers in the package;]

placing the die on the lead fingers with the adhesive material in contact with the die and the lead fingers to form an adhesive layer therebetween;

curing the adhesive material at the temperature and in the ambient atmosphere in less than about 60 seconds to bond the die to the lead fingers;

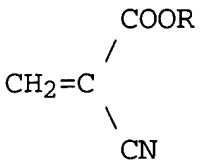
wire bonding the die to the lead fingers; and

encapsulating the die.

15. (four times amended) A method for packaging a semiconductor die to form a semiconductor package, comprising:

providing a leadframe configured for wire bonding to the die;

providing an adhesive material having the formula:



wherein R is a hydrocarbon group, the adhesive material formulated to cure in less than about 60 seconds <u>in contact with the die</u> at a temperature of about 20°C to 30°C and in an ambient atmosphere;

providing a filler in the adhesive material selected to [improve] <u>tailor</u> a characteristic of the adhesive layer in the package;

applying the adhesive material to the leadframe or to the die;

applying a catalyst to the leadframe or to the die;

placing the die on the leadframe with the adhesive material compressed between the die and the leadframe to form an adhesive layer therebetween;

curing the adhesive layer at the temperature and <u>in</u> the ambient atmosphere in less than about 60 seconds by interaction of the adhesive material with the catalyst to bond the die to the leadframe;

wire bonding the die to the lead frame; and

encapsulating the die.

21. (five times amended) A method for packaging a semiconductor die to form a semiconductor package comprising:

providing a leadframe configured for wire bonding to the die;

providing an adhesive material comprising an anaerobic acrylic formulated to cure in contact with the die in less than about 60 seconds at a temperature of about 20°C to 30°C and in an ambient atmosphere;

providing a filler in the adhesive material comprising a material selected from the group consisting of SiO_2, Al_2O_3, AlN, Ag, Ni, Fe, SiC, and polystyrene coated Ni;

applying the adhesive material to the leadframe or to the die;

placing the die on the leadframe with the adhesive material compressed between the die and the leadframe to form an adhesive layer therebetween;

curing the adhesive material at the temperature and in the ambient atmosphere in less than about 60 seconds to bond the die to the leadframe;

wire bonding the die to the lead frame; and

encapsulating the die.

42. (four times amended) A method for packaging a semiconductor die to form a semiconductor package, comprising:

providing a leadframe comprising a plurality of lead fingers configured to support the die and configured to provide sites for wire bonding to the die;

providing an adhesive material comprising an anaerobic acrylic formulated to cure in contact with the die in less than about 60 seconds at a temperature of about 20°C to 30°C and in an ambient atmosphere;

providing a filler in the adhesive material selected to improve the dielectric strength of the adhesive material in the package;

applying the adhesive material to the die or to the leadframe;

placing the die on the leadframe with the adhesive material in contact with the die and the leadframe to form an adhesive layer therebetween;

curing the adhesive material at the temperature and in the ambient atmosphere in less than about 60 seconds to bond the die to the leadframe;

wire bonding the die to the lead fingers; and

encapsulating the die.